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# Lincoln University Digital Dissertation

# The Last Straw?

## A Discussion of Cumulative Effects Assessment and its Role in Environmental Decision Making.

Presented in partial fulfilment of the requirements for the Degree of Master of Science (Resource Management)

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# Abstract

The aim of this investigation was to identify and discuss the issues relating to cumulative effects assessment and its role in decision making. The report centres around four main research questions: What is cumulative environmental change? How can cumulative effects be evaluated? How are cumulative effects analysed? And how can cumulative effects be incorporated into decision making and policy development?

A theoretical 'framework for analysis' is formulated as a means for evaluating cumulative effects. Tools to assess cumulative effects are 'tested' against this 'framework for analysis.' Emphasis is on strategic assessment incorporating both normative and empirical analysis. It is recognised that institutional and political factors also influence cumulative effects assessment. These include: resource issues; institutional fragmentation; and ambiguities in assessment. Issues specific to the Resource Management Act (1991) in New Zealand are discussed. The institutional context under the RMA (1991) offers both obstacles and opportunities. Recommendations specific to New Zealand are outlined to help overcome some of the recognised barriers and further the opportunities.

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# Acronyms

AEE - Assessment of Environmental Effects

CBA - Cost Benefit Analysis

CEA - Cumulative Effects Assessment

CEARC - Canadian Environmental Assessment Research Council

CEQ - Council on Environmental Quality

CIA - Cumulative Impact Assessment

EIA - Environmental Impact Assessment

EPEP - Environmental Protection and Enhancement Procedures

GIS - Geographic Information Systems

MfE - Ministry for the Environment

NEPA - National Environmental Policy Act

NEPP - National Environmental Policy Plan

PCE - Parliamentary Commissioner for the Environment

RA - Risk Assessment

RMA - Resource Management Act

SEA - Strategic Environmental Assessment

SIA - Social Impact Assessment

SOE - State of Environment Monitoring

UNCED - United Nations Conference on Environment and Development

UNEP - United Nations Environment Programme

# Contents

# 1.0 Introduction

## 1.1 The Importance of Cumulative Effects Assessment

Cumulative environmental change refers to the effects of multiple inputs to, or withdrawals from, natural systems (Cocklin, Parker and Hay, 1992b: 51).

> "Explicit in the study of cumulative change is a recognition that the existent state of the environment is not simply the product of individual impacts occurring independently of each other. Environmental change is in fact the consequence of many interacting factors, the combined effects of which are not always well understood" (Cocklin, Parker and Hay, 1992b: 51).

Throughout the world, consideration of cumulative threats to the environment by planners and politicians alike, continues to be limited (Hirsch, 1988: 715; Tasker, 1997). Many judgements continue to be made on an ad hoc and case by case basis without the assessment of, and information about, their cumulative effects (Hirsch, 1988: 715). Incremental decision making commonly prevails, resulting in uncontrolled and often unintended cumulative environmental change. Usually, this process does not produce an optimal, desired or preferred solution for society and has been aptly termed by Odum (1982: 728) as the "tyranny of small decisions."

For instance, the ecological integrity of the Florida Everglades was not destroyed by a single adverse decision but rather by a multitude of small projects, all legally permitted by state and federal regulatory agencies charged with protecting the wetland resource (Johnston, Detenbeck, Bonde and Niemi, 1988: 1609).

> "These included a series of independent choices to add one more drainage canal, one more roadway, one more retirement village and one more well to provide Miami with drinking water" (Odum, 1982: 728).

Perhaps the most widespread and important cumulative effect of human activities on the terrestrial environment is landscape modification, primarily to provide more products for human consumption (Orians, 1995: 8). For instance, humans replace complex ecosystems with cultivated areas dominated by single species and with pastures for domestic livestock. The individual actions are local and rarely have major consequences. In total, however, the effects of 'step-by-step' landscape modification are great and include diminishing biological diversity and endangering species that cannot maintain viable populations without their habitats (Orians, 1995: 8).

Other examples of cumulative environmental change with serious global consequences include global warming and acid rain. Global warming is associated with the accumulation of large amounts of carbon dioxide into the atmosphere which in turn is directly related to the burning of fossil fuels and deforestation. The acid rain phenomenon prevalent in North America and Europe is the cumulative result of sulfur oxides released by industry and nitrogen oxides emitted by automobiles (Curtis and Barnes, 1989: 50). The potential consequences of both climate change and acid rain include: lowered crop yields; decreased timber production; loss of important freshwater fishing areas as well as the monetary and social costs of allowing such phenomena to continue. Both examples of cumulative environmental degradation display the vulnerability of the earth's ecosystem to pollutants that respect no boundaries (Curtis and Barnes, 1989: 50).

Cumulative environmental change is also apparent in New Zealand. Native forest destruction, loss of wetland habitats and groundwater pollution are all unintended consequences arising from the combination of many 'individual' actions.

## 1.2 Institutional and Political Recognition of Cumulative Effects

### 1.2.1 International Recognition of Cumulative Effects

The implications of cumulative environmental effects on human society are not merely a modern occurrence, but rather are readily apparent throughout history.

> "The decline of ancient civilisations in Mesopotamia is attributed in part to incremental changes in environmental conditions particularly increases in soil salinity and sedimentation induced by centuries of irrigation" (Spaling and Smit, 1993: 587).

Despite this historical recognition, cumulative environmental effects have only been widely recognised institutionally in the past few decades (Spaling and Smit, 1993: 588).

International awareness of environmental problems increased significantly following the 1972 United Nations Conference on the Human Environment in Stockholm, which initiated the United Nations Environment Programme (UNEP). Although cumulative effects received little attention at that conference, subsequent international agreements have dealt with issues relating to cumulative change including; ozone depletion, global warming, population growth, and loss of biological diversity (Orians, 1995: 14).

The cumulative effects concept was arguably introduced in the institutional setting two decades ago by the United States Council on Environmental Quality (CEQ) (Johnston et al, 1988: 1609). The CEQ, in their recommendations for implementing the National Environmental Policy Act (NEPA), defined cumulative environmental change as:

> "the impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertaking such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (quoted from Hirsch, 1988: 718).

In 1985, the Canadian Environmental Assessment Research Council (CEARC) and the United States National Research Council jointly sponsored a conference on cumulative environmental effects (Cocklin, Parker and Hay, 1992a: 33). The conference demonstrated a number of things: cumulative environmental change was seen to be an issue by many scientists; ambiguities in the definition of cumulative effects were exposed as was the need for institutional change required for appropriate cumulative effects assessment. The Conference helped to set the agenda for future work on cumulative effects and gave momentum to that research effort (Cocklin, Parker, and Hay 1992a: 33).

The most recent attempt to deal with cumulative effects and promote sustainable development in the international context was the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992 (Orians, 1995: 13). The resulting documents and treaties including the Rio Declaration on Environment and Development, Agenda 21 and the Framework Conventions on Climate Change and

Biological Diversity, display the increasing global recognition of the need to prevent cumulative environmental degradation.

### 1.2.2 Recognition of the Importance of Cumulative Effects in New Zealand

It appears that the first significant reference to cumulative environmental effects in New Zealand legislation was in the Resource Management Act 1991 (RMA). This Act aims at sustainable management by controlling the adverse effects of activities on the environment. Section 3 of the RMA defines 'effect' as including *"any cumulative effect which arises over time in combination with other effects regardless of the scale, intensity, duration or frequency of the effect."*

The Resource Management Act (1991) establishes a framework for environmental policy making and assigns authority and power to territorial and regional government for policy planning and decision making (Bührs and Bartlett, 1993: 133). The resource consent hearing process at the local government level should deal with the effects (including cumulative effects) of particular activities on the environment and plans should cater for the wider use and management of resources.

## 1.3 Problem Statement

Cumulative environmental change is an internationally recognised phenomenon. In New Zealand, legislation requires planners and decision makers to incorporate assessment of cumulative effects into resource management decisions. Yet, cumulative environmental

change continues to occur at a local, national and global level with undesirable consequences. The question arises - why does cumulative environmental degradation continue? Apparently, despite being recognised as important, the incorporation of cumulative effects in decision making is problematic. Hence, the aim of this investigation is to identify and discuss the issues relating to cumulative effects assessment and its role in environmental decision making.[1]

## 1.4 Research Questions

Spaling and Smit (1993) highlight the many conceptual frameworks of cumulative environmental change that have emerged in literature. They recognise there is no commonly accepted definition or interpretation nor is there one approach to assessing and evaluating cumulative effects. Rather, there are many different mechanisms, in part associated with differences in national context such as political and judicial systems as well as conceptual and institutional dissimilarities (Spaling and Smit, 1993: 588).

Spaling and Smit (1993) broadly group the many terms and definitions that have emerged to describe cumulative environmental change into four categories (refer Table One). These categories form the scope and structure of this research and influence the research questions seen below:

[1] This report is based on the assumption that humans will never know everything about everything; we do not know enough about causal relationships; have difficulty predicting second -, third- and fourth-order impacts and lack the tools for predicting temporal and spatial impacts (Dixon and Montz, 1995: 446). Notwithstanding this, cumulative effects assessment with its varying degrees of complexity can and should be attempted to promote sustainable management as aspired to in the Resource Management Act (1991).

| Perspective | Term | Selected Reference |
|---|---|---|
| Phenomena | Cumulative environmental change | Cocklin et al (1992a,b) |
| | Cumulative environmental effects | Vlachos (1983) |
| Analytical | Cumulative environmental impact assessment | Dixon and Montz (1995) |
| | Cumulative effects analysis | Stakhiv (1988) |
| | Assessment of cumulative effects | Vlachos (1983) |
| Evaluative | Cumulative Effects Assessment | Constant and Wiggins (1991) |
| | Cumulative Impact Analysis | Dickert and Tuttle (1985) |
| | | Orians (1995) |
| | | Stakhiv (1988) |
| | | Vlachos (1983) |
| Planning | Cumulative Impact Analysis | Gosselink et al (1990) |
| | Cumulative environmental assessment and management | Hirsch (1988) |
| | | Irwin and Rhodes (1992) |

Table One - An eclectic range of terms to describe cumulative change.
Source: Adapted from Spaling and Smit (1993: 588).

1. What is cumulative environmental change?

As indicated in Table One there are many different interpretations of cumulative effects. These diversity of views create difficulty when it comes to analysing and incorporating the concept into decision making. There have been a number of attempts to outline a conceptual framework for cumulative effects in the literature and in particular at the CEARC conference. Section Two of this report reviews this literature and examines the problematic nature of defining a concept that crosses many spatial, temporal and disciplinary boundaries. The purpose of Section Two is to outline an interpretation of cumulative effects assessment that will be used later in the study.

2. How can cumulative effects be evaluated?

How cumulative effects are evaluated depends on: the interpretation of the concept; the political and institutional context in which the assessment is undertaken; and also the value base of society. These questions differentiate the theoretical issues of

whether cumulative effects can or should be assessed and the practical matter of how cumulative effects are assessed[2]. Section Three of this report, reviews selected literature regarding the theoretical aspects of analysing cumulative effects. Connections are made between the interpretation of cumulative effects in Section Two and a framework for its analysis.

3. How are cumulative effects analysed?

   Section Three's framework for analysis can be used to assess specific tools that have been identified by literature as contributing to cumulative effects assessment. The purpose of Section Four is to identify the tool (or combination of tools) that is best suited to assess cumulative effects based on the criteria identified in the framework for analysis.

4. How can cumulative effects be incorporated into decision making and policy development?

   Decision making with respect to cumulative effects needs to incorporate the tools and mechanisms of assessment as well as political, economic and institutional requirements. The purpose of Section Five is to tie the previous sections together by outlining the conditions that need to be fulfilled for the meaningful implementation of cumulative effects assessment. Whereas previous sections have discussed cumulative effects at the general level, Section Six focuses on the New Zealand context.

[2] A number of questions have been raised in literature regarding how cumulative effects should be analysed and what controls and measures are available to assess cumulative effects. However, discussion is limited to research disciplines such as cumulative effects assessment in the field of environmental impact assessment, geographic information systems, or the process of plan formulation. Often these tools and methods are discussed without the knowledge of exactly what such methods need to address.

Literature reviews and interviews with environmental impact assessment practitioners and policy analysts at local and central government highlight the many issues associated with cumulative effects assessment in New Zealand. Section Six is designed to examine how well cumulative effects assessment under the Resource Management Act (1991) conforms with the implementation conditions outlined in Section Five.

Finally, conclusions and recommendations are outlined in Section Seven. Recommendations are designed to 'progress' the issues identified throughout the study based on the four research questions and have been prioritised to promote strategic implementation.

# 2.0 Cumulative Environmental Change: Interpretations

## 2.1 Introduction

The purpose of this Section is to examine existing interpretations of cumulative effects and outline a classification of cumulative effects that can be built into a framework for analysis in Section Three.

This Section will first discuss the complexity of the cumulative effects concept. Second, a review of existing conceptual frameworks relating to cumulative effects will be undertaken. Limitations and disagreements highlighted in literature regarding the existing frameworks will be examined. Third, the classification of cumulative effects to be used in this report will be outlined.

## 2.2 The Complexity of Cumulative Effects

There is no universal definition of cumulative effects. Interpretations differ depending on spatial and temporal contexts as well as on the many dimensions of the environment. These different expositions do not relate specifically to cumulative environmental change assessment but are more broadly linked to the field of environmental assessment.

Cumulative environmental change arises from boundless human activities over time and space. Changes occur over time scales much longer than forecasts and assessments normally utilised in planning and policy decisions (Spaling and Smit, 1993: 587). Spatial

changes occur at local, regional, national and even global scales. *"Changes over time and space accumulate and compound so that, in aggregate, the effect exceeds the simple sum of previous changes"* (Spaling and Smit, 1993: 587).

Cumulative effects can be positive and negative. They are applicable to socio-cultural perspectives, economic systems and ecological elements. The earth should be viewed as a dynamic and interlinked ecosystem in which changes in one dimension, such as the biophysical sphere, will have dramatic consequences in other environmental domains (economic, political and socio-cultural).

Any classification of cumulative effects must recognise the complex nature of the concept and the diversity of views. It must also find a way to deal with the time, space and activity dimensions that are at the core of the cumulative effects concept.

## 2.3 The Different Interpretations of Cumulative Effects

The CEARC conference (1985) recognised ambiguities in the definition of cumulative effects. As a result, a conceptual framework was formulated based on the views highlighted at this forum. Many cumulative effect advocates have adapted the CEARC typology to incorporate their own personal views on cumulative effects.

In general, conceptual frameworks of cumulative change are based on a model of causality, consisting of three components: causes or sources of change; processes of change; and resulting effects (Spaling and Smit, 1993: 591). The following three

typologies, represent the differing interpretations of cumulative effects outlined in selected literature and attempt to manage the complexity associated with the concept.

### 2.3.1 CEARC Typology

The joint Canadian and United States conference in 1985 produced a typology of cumulative effects (refer Table 2). The typology identifies eight types of cumulative effects differentiated primarily on the basis of temporal and spatial attributes.

| Type | Main Characteristics | Examples |
|---|---|---|
| Time Crowding | Frequent and perpetual effects on a particular environmental medium | Waste discharges into groundwater or surface water |
| Space Crowding | High density impacts on a single environmental medium | Deforestation<br>Eutrophication in lakes |
| Compounding Effects | Synergistic effects arising from multiple sources on a single environmental medium | Gaseous emissions into the atmosphere from industry, vehicles and domestic burning |
| Time Lags | Long delays in experiencing impacts | Carcinogenic effects |
| Extended Boundaries | Effects identified some distance from source | Acid rain phenomenon |
| Triggers and Thresholds | Disruptions to ecosystem processes that fundamentally change the systems behaviour | The greenhouse effect,<br>Ozone depletion |
| Indirect Effects | Secondary effects resulting from a primary activity | Increase in retail sales resulting from tourist development |
| Patchiness Effects | Ecosystem fragmentation | Subdivision on wetlands<br>Forest harvesting |

Table Two: A typology of cumulative environmental change from the CEARC conference. Source: Adapted from Cocklin, Parker and Hay (1992a: 35).

This typology describes the types of cumulative effects that should be considered in environmental assessments. It has not been tested in an applied environmental assessment setting (Spaling and Smit, 1993:591) and its usefulness in practice is doubted by a number of critics (Spaling and Smit, 1993, Cocklin et al, 1992a). The major limitation of this typology is that it mixes criteria.

> "Some categories refer to processes of environmental change (e.g. time crowding, space crowding), others to form or structure (e.g. nibbling or patchiness), and others to indicators (e.g. thresholds)" (Spaling and Smit, 1993: 593).

Although the complexity and diversity of views regarding the concept have been outlined, the criteria would be very hard to put into practice. Although, temporal and spatial phenomena relating to cumulative effects are outlined there is no reference to what time span or spatial boundary is feasible for analysis. There is also much focus on the biophysical elements of cumulative effects and little reference to socioeconomic aspects.

### 2.3.2 Source, Pathway and Effect Typology

Cocklin, Parker and Hay (1992a) have produced a cumulative effects typology which combines three dimensions: sources of change; pathways of accumulation; and impact accumulation. Table Three outlines these dimensions and provides examples of each component.

In general terms, sources of change can be defined as either single or multiple. A single activity will have multiple effects on the environment. Several forms of a single activity can have individually minor, but collectively significant environmental effects (Cocklin and Parker, 1993: 395). This concept is similar to the "time and space crowding" criteria in the CEARC typology. Cumulative effects are also a consequence of multiple activities where assessment focuses on the combined impacts of two or more sources of disturbance (Cocklin and Parker, 1993: 395).

| Type | Main Characteristics | Examples |
|---|---|---|
| Sources of Change | Multiple units of a common type | Multiple subdivisions having cumulative consequences on the availability of versatile soils |
| | Disparate Multiple Sources | Industry, vehicle and domestic fire emissions on air pollution |
| Pathways of Accumulation | Impacts on various environmental parts remain effectively disjunct | Subdivision results in linear loss of land to other development |
| | Processes that combine impacts additively and synergistically | Eutrophication of lakes due to excessive biological oxygen demand |
| | Processes that compound | Chemical compounds, such as DDT, accumulate through the food chain |
| | Indirect Effects | Secondary impact of not allowing rural subdivision may be greater pressure on urban systems through infill housing |
| Impact Accumulation | Accumulation of impacts upon the environment | In any region, industry, domestic burning and vehicles giving rise to air pollution, intensive farming leading to water pollution and deforestation resulting in a loss of biological diversity |
| | An accumulated impact upon a single environmental component | The burning of fossil fuel releases carbon dioxide and agricultural activities give rise to outputs of methane, both contributing to climate change. |

Table Three: The concept of Cumulative Environmental Change

Cocklin and Parker (1993: 395) recognise two main pathways of disturbance; additive/crowding and interactive/compounding (refer Table Three). An additive/crowding pathway is characterised by linear inputs or withdrawals, where each unit of activity creates a similar level of disturbance. An interactive/compounding pathway recognises the combined effect of progressive inputs or withdrawals may not be linear and additive. For example, pollutants may accumulate gradually, until toxicity is such that the ecosystem changes fundamentally in its characteristics. This phenomenon is

similar to the CEARC criterion - "triggers and threshold effect" - which occurs when an activity or influence reaches a certain level. Interactive/compounding pathways also incorporate synergistic effects. Synergistic effects occur when two or more inputs in combination are greater than the added effects of each acting independently[3] (Cocklin, Parker and Hay, 1992: 37).

Like the CEARC typology, Cocklin and others (1992a: 37) also associate cumulative effects with indirect or secondary effects of human actions. Indirect effects may occur simultaneously with the activity or they may occur in the future ('time lag'). For example, carcinogenic effects generally require long-term exposure before symptoms emerge (Spaling and Smit, 1993: 593). Secondary effects may also occur in the same spatial location as the activity or they may occur in 'extended boundaries.'

Table Three outlines the distinction between an *"accumulation of impacts"* and an *"accumulative impact."* The former is *"a situation in which there is a diverse range of impacts, perhaps unrelated, which contribute to an overall degradation of the environment"* (Cocklin and Parker, 1993: 395). Conversely, an "accumulative impact" occurs *"when two or more, perhaps unrelated, activities contribute to a single form of environmental disturbance"* (Cocklin and Parker, 1993: 395).

[3] It should also be noted that in some cases several of the accumulation pathways may be in evidence depending on the nature of the activity and the characteristics of the receiving environment (Cocklin, Parker and Hay, 1992a: 37).

Cocklin, Parker and Hay's (1992a) typology is similar to the CEARC typology. However, they place greater emphasis on activities and their consequences than temporal and spatial elements. For instance, Cocklin et al (1992a) only refer to 'time lags' and 'extended boundaries' in the context of indirect and secondary effects. There is also no reference to 'patchiness effects' which were outlined in the CEARC typology. Cocklin et al (1992a) may have deliberately omitted these components to avoid mixing criteria, hence overcoming a recognised flaw in the CEARC typology.

The emphasis on cause and effect makes Cocklin et al's (1992a) typology a more practical classification of cumulative effects. Instead of merely listing the elements of cumulative effects, the typology outlines a means of assessment and a way of dealing with the complex nature of the concept. Analysis can incorporate any spatial and temporal level and incorporate socioeconomic and biophysical perspectives. The scope of analysis will depend on the assessment's purpose and resources available to the practitioner and is discussed further in Section Three.

### 2.3.3 Vlachos's Typology

Table Four, below, outlines the dimensions of cumulative environmental change as interpreted by Vlachos (1983). According to Vlachos (1983: 63), cumulative effects should contain three distinct elements:

1. The sum incremental effects on the surrounding environment resulting from multiple human activities (including: direct, indirect, linear and piecemeal effects);
2. Synergistic effects - including compounding and interactive effects; and

3. Impacts which are relatively insignificant until some undetermined threshold value is reached (for instance an 'accumulative impact' or 'accumulation of impacts').

| Type | Main Characteristics | Other typologies criterion |
|---|---|---|
| Sum incremental effects | Aggregative - addition or summing of impacts of identical or related actions | Cocklin et al's (1992a) additive/linear pathway |
| Synergistic effects | Interactive - underscores the cross-effects of related actions | Cocklin et al's (1992a) compounding/interactive pathway, synergistic effects |
| | Diachronic - underlines the influence and importance of an extended time horizon | CEARC's (1985) 'time lag', 'extended boundaries' and 'triggers and threshold' criteria |
| Significant impacts | Altered spatial relations - based on additive, interactive and diachronic effects | Cocklin et al's (1992a) accumulative impact or accumulation of impacts |
| | Structural differentiation and/or sociocultural changes | No other typology specifically mentioned the socio-cultural dimension |

Table Four: Vlachos's (1983) interpretation of the dimensions of cumulative effects

Vlachos (1983: 62) recognises that a central principle relating to cumulative impacts requires some "ideal" state of the environment being disturbed by the collective effects of a given project or action. Like the other typologies outlined in this section, Vlachos (1983) highlights the temporal and spatial dimension of cumulative effects. *"The judgement of whether impacts are significant requires a look beyond both the spatial limits of a given area and the narrow goals of a piecemeal or individual action"* (Vlachos, 1983: 62).

Vlachos's typology is similar to Cocklin et al's (1992a) in that it looks at cause and effect and also outlines the different pathways of accumulation: addition, compounding (synergism) and diachronic. Vlachos's (1983) typology is the only classification that

explicitly identifies cumulative impacts as being beneficial as well as adverse. It also highlights the importance of the socioeconomic dimension of cumulative impacts including overall changes in socioeconomic lifestyles and values.

## 2.4 Conclusion and Interpretation for this Study

The cumulative effect typologies discussed above have many similarities. All emphasise the totality of interactive impacts over time and space and all discuss additive/linear and compounding/interacting effects. However, some are more complex than others. The CEARC typology describes the many components of cumulative change in a way that is very hard to apply in practice. Cocklin et al's typology and Vlachos's typology are similar in that both contain cause and effect dimensions. However, Cocklin et al's typology is more practical and will therefore be used in this report. This classification is recognised in literature (Spaling and Smit, 1993: 591) as being a refined model of other typologies and is able to be used for assessment purposes. Within this typology, socioeconomic and biophysical effects can be incorporated in cumulative effects assessment as well as positive and negative cumulative effects.

The next section will examine the issues involved in an assessment of cumulative effects based on the typology outlined by Cocklin et al (1992a).

# 3.0 A Framework for Cumulative Effects Analysis

## 3.1 Introduction

The purpose of this section is to discuss the theoretical aspects of cumulative effects assessment and formulate a 'framework for analysis.' This framework will be used later in the report as a basis to 'test' tools for analysing cumulative effects. The cumulative effects typology outlined in Section Two will be incorporated into the 'framework for analysis' as will normative and empirical values identified in selected literature.

This section will first outline the types of inquiry that could contribute to cumulative effects assessment based on the interpretation outlined in Section Two. Second, the limitations and benefits for practical assessment of such enquiries will be examined. Third, the need for a change in traditional assessment techniques is examined. Finally, the 'framework for analysis' is outlined.

## 3.2 Types of Inquiry

The typology outlined by Cocklin et al (1992a) in the previous section provides a classification by which analysis of cumulative environmental change can be undertaken. Based on this classification, Cocklin and Parker (1993: 395) identify four types of inquiry that could contribute to cumulative effects assessment (refer Table Five):

| | | Environmental Attributes (effect) | |
|---|---|---|---|
| | | Single | Multiple |
| Activity (cause) | Single | 1 | 2 |
| | Multiple | 3 | 4 |

Table Five: Four types of inquiry inherent in cumulative effects assessment

1. *"Assessment of the effects of a single activity upon a single environmental attribute."* Cumulative environmental change can be analysed in the local context by, for example, assessing the effect of subdivision on groundwater in that local area. Such an assessment can be over any temporal scale. For instance, analysis may be of an individual activity that recurs over time. This type of analysis depends heavily on additive approaches of primary and secondary cumulative effects resulting from an activity.

2. *"Assessment of the effects of a single activity upon multiple environmental attributes."* This local assessment is more complex than the above analysis of cumulative environmental change. It requires assessment of more than one environmental medium and therefore looks at environmental processes/pathways of accumulation. For instance, chemicals from a forestry operation may combine with existing chemicals in the soil or water and fundamentally change system behaviour by reaching a threshold level. Analysis could be regional, assessing spatially dispersed effects and incorporate time crowding and time lag dimensions of cumulative effects.

3. *"Assessment of the effects of multiple activities (independent or related) upon a single environment attribute."* This analysis incorporates the 'accumulative impact' dimension

of Cocklin et al's (1992a) typology. For instance, a number of activities such as farming, subdivision and forestry with their effects on groundwater would be incorporated in assessment. Analysis may be local or regional and look at the combined impacts of disturbance - either in an additive/crowding pathway or interactive/compounding pathway.

4. *"Assessment of the effects of multiple activities upon multiple environmental attributes."* Analysis of cumulative environmental effects regarding an 'accumulation of impacts' is very complex. Analysis extends to all spatial scales - local, regional, national and even global levels - and requires forecasting future effects. All effects resulting from human activities - mining, deforestation, subdivision, industrial sites, etc. - are assessed on all environmental attributes: social, economic and biophysical. Not only are combined effects assessed (additive/crowding and interactive/compounding) but also the secondary effects of multiple activities.

## 3.3 Limitations relating to the levels of assessment

Analysis of cumulative effects at the global level is extremely complex[4]. Questions arise as to who would undertake such an assessment, whose values would be taken into account (considering the analysis would be across cultures and political beliefs), and what tools are available to assess such a wide spatial scale? It is also unrealistic to assess cumulative effects resulting from all human activities on all environmental media at any

[4] There has been examples of cumulative analysis at a global level. For instance, $CO_2$ emissions and deforestation, however, these assessments are limited to looking at only one environmental medium and may also be ineffective within a time-frame that 'matters.'

level (local, regional, national or global). The information requirements would be too large and non-computable. There is therefore a pragmatic need to minimise the scope and complexity of analysis in both the temporal and spatial dimensions

### 3.3.1 Spatial Dimension

Three levels of assessment can be summarised based on the above four enquiries. Table Six outlines the characteristics of these analyses and highlights some of their advantages and disadvantages[5].

For the purposes of this study a regional approach to cumulative effects assessment is advocated. This level of analysis is manageable on an information scale and yet still allows for assessment of ecosystem processes (interactive/compounding pathways). It also incorporates an interdisciplinary approach.

The 'regional approach' outlined by Cocklin et al (1992a: 44) does not detail the extent to which ecosystem processes should be assessed. A regional approach to assessment may enable analysis of some processes across a large spatial area, but there is limited tools and mechanisms to examine all processes. Most cumulative effects literature (Vlachos, 1983, Spaling and Smit, 1993) identify synergism as being central to the philosophy of cumulative effects . They also recognise that there is no one tool that can deal with this phenomenon comprehensively.

[5] Global consideration is excluded based on those points previously discussed.

| Scope of Analysis | Characteristics | Type of Inquiry | Advantages | Limitations |
|---|---|---|---|---|
| Project Analysis | Analysis of a particular source of change and the resulting cumulative effects. The purpose of CEA is to identify how outputs from this activity impact directly upon the environment and how they interact with other outputs of human activity to bring about environmental change | 1 and 2 | Less complex analysis<br>Fits in better with traditional approaches to environmental impact assessment | Ad hoc - cumulative environmental change is not the consequences of individual actions added together<br>More reactive than proactive<br>Reductionist<br>Cumulative effects assessment needs a new way of thinking about impact assessment not just how to fit under existing institutional principles |
| Regional Analysis | Focus on the full range of impacts within a spatially defined area. Ecosystem process assessed | 3 and 4 | Recognises that environmental change is not the product of developments occurring in isolation<br>A new way of looking at impact analysis<br>Anticipatory<br>Interdisciplinary/ holistic | Complex analysis<br>Requires institutional change |
| Ecosystem Approach | Variation of the regional approach. Boundaries defined more by ecological reference than to socio-economic or political boundaries | 3 and 4 | Same as above but not as interdisciplinary<br>Boundaries based on 'physical' dimensions such as a water catchment therefore allowing for easier analysis of inputs and withdrawals to the 'system' | Same as above but more reductionist than regional approach due to greater focus on biophysical elements<br>May require a change in institutional boundaries |

Table Six: Types of analysis based on the four enquiries outlined by Cocklin et al (1992a)

Vlachos (1983: 68) suggests that analysis should not be expected to provide definitive answers to cumulative impact questions. It should not be required to provide long lists of impacts, but rather, the scope and objectives associated with cumulative impact analysis

should be based on value judgements and desired futures as well as empirical knowledge regarding concepts such as 'thresholds, significance and levels of tolerance.'

### 3.3.2 Temporal Dimension

Defining a temporal scale is also important in a framework for analysis because the *"existing state of the environment is the product of events throughout history"* (Cocklin, et al, 1992a: 44). The temporal boundaries defined for any cumulative effects assessment relates in part to cultural values. For instance, western culture emphasises short term future impacts without sufficient reference to the past (Cocklin et al, 1992a: 44). As a result, environmental degradation from past human actions such as desertification due to deforestation is repeated throughout the ages. While some cultures believe planning for the future requires looking ahead 10 or 20 years, other cultures, such as some from the east anticipate effects hundreds of years into the future.

Incorporation of a temporal dimension into any analysis has inherent problems. Historical data is often not in the required format, if available at all. Cocklin, et al (1992a: 39) believe that the lack of empirical data based on historical cumulative change will hinder application of past events into today's cumulative effects assessment. They do not recognise the importance of values and normative information in assessment of cumulative effects. Values in today's society are a result of past and present events.

Yet incorporation of values in any assessment is also problematic. Values change over time, therefore what was considered important fifty years ago may not be important now. Values of future generations are also unknown and can only be estimated at best.

> "What are seen as desirable social goals at one time, and are therefore acted on then, may subsequently be in conflict with later societal goals, and meanwhile may have caused irreparable damage to environmental systems" (Stakhiv, 1988: 729).

The temporal issues surrounding societal goals of action can be overcome by putting in place static and dynamic objectives. For instance, some goals are inviolate, such as legally mandated air or water quality standards. Others are desired objectives or professionally accepted criteria that can be raised or lowered depending on circumstances and public input (Stakhiv, 1988: 733). For instance, the significance of an effect will be based on what 'society' views as the most desirable level and lowest acceptable level of effect. Peoples values and objectives regarding what is acceptable to them will differ with changing information and values.

## 3.4 A different way of thinking

Most cumulative effects literature (Spaling and Smit: 1993, Dixon and Montz: 1995) recognises limitations in existing impact assessment tools such as 'traditional' environmental impact assessment. Yet, commentators apparently believe small changes to their scope will allow cumulative effects to be assessed adequately. Conversely, Vlachos, (1983: 68) suggests that cumulative effects assessment must differ from traditional assessments of effects.

> "The demand for cumulative impact assessment requires a complete restructuring of the problem itself; an articulation of the assumptions driving the assessment; new techniques and tools for aggregating diverse impacts; and a search for standards or criteria of significance in order to judge overall, long-range impacts" (Vlachos, 1983: 68).

Table Seven, summarises the difference between traditional assessment procedures and the new way of thinking that is inherent in cumulative effects assessment.

| Established Procedures (Traditional) | New Emphasis (Alternatives) |
|---|---|
| Species Oriented | Regional/Process oriented |
| Linear | Compounding and Synergistic |
| Causal | Interactive |
| Reductionist | Holistic |
| "Snapshot" | Dynamic |
| Hierarchal/classification | Contextual/relevance-selected |
| Structural | Functional |
| Reactive | Anticipatory |

Table Seven: The shift in emphasis
Source: Adapted form Vlachos; 1983: 68

## 3.5 A Framework for Analysis

The scope and objectives of a cumulative effects assessment will depend on value judgements and desired futures as well as the availability of empirical knowledge and tools to assess the many dimensions of cumulative effects.

However, in general a **regional** cumulative impact assessment should encompass the following:

- An understanding of the current state of the environment and the cumulative change processes currently in existence;
- An assessment of the extent to which cumulative effects in the past have conditioned the existing environment;

- An approach to assessing compounding/synergistic pathways and additive/linear processes;
- An examination of biophysical and socioeconomic effects and their interactions;
- Assessment of threshold and resilience levels of the supporting environment;
- A process for incorporating values regarding significance, etc;
- Anticipation of future effects;
- Consideration of priorities for future environmental management based on empirical and normative values; and
- A flexible and ongoing process that can adapt to changes in value and knowledge systems.

The next section will use this 'framework for assessment' as a basis to see which tools (or combination thereof) are necessary in a methodology for cumulative environmental effects.

# 4.0 Cumulative Effect Assessment Methodology

## 4.1 Introduction

The purpose of this section is to examine what tools may be used in a cumulative effects assessment. Discussion is at both a general and theoretical level[6] and is aimed at assessing limitations and advantages of each tool by assessing it against the 'framework for analysis' outlined in Section Three.

Project based environmental impact assessment (EIA) is often examined in the context of cumulative effects assessment as is environmental impact assessment of plans and policies (also called strategic environmental assessment - SEA). Other tools referred to in literature (generally in passing) as contributing to the assessment of cumulative effects include state of the environment monitoring (SOE), geographic information system (GIS), social impact assessment (SIA) and risk assessment (RA).

This section will first discuss the diverging perspectives relating to cumulative effects assessment. Second, the tools referred to above will be assessed in relation to the 'framework for analysis' and conclusions made as to their suitability.

[6] The next section will look at political and institutional issues that are inherent in any cumulative effects assessment.

## 4.2 Assessing tools against the 'framework for analysis'

Previous studies of cumulative effects assessment tend to be extensions of 'traditional' environmental impact assessments. Analysis is based on lists of critical variables, modeling of important environmental dimensions, and linear/incremental projects (albeit on extended space and time dimensions) (Vlachos, 1983: 71).

Spaling and Smit (1993) recognise two diverging perspectives in literature regarding cumulative effects assessment. The first approach encompasses 'scientific' and 'objective' thinking and is based on models which aid the understanding of component parts. Cumulative environmental assessment is viewed primarily as an information generating and gathering activity. The second approach tends to be more holistic and views cumulative effects assessment in a *"visionary, futuristic manner,"* recognising far-reaching consequences against alternative scenarios (Vlachos, 1983: 73).

As stated previously, cumulative effects assessment requires a change in the 'traditional' way of thinking. Instead of an assessment encompassing just one of the above perspectives, both must be apparent within a single analysis. This theory is reflected in the 'framework for analysis' formulated in Section Three.

Figure One outlines a combination of tools, incorporating both rational and normative perspectives, that could be used in assessing cumulative effects.

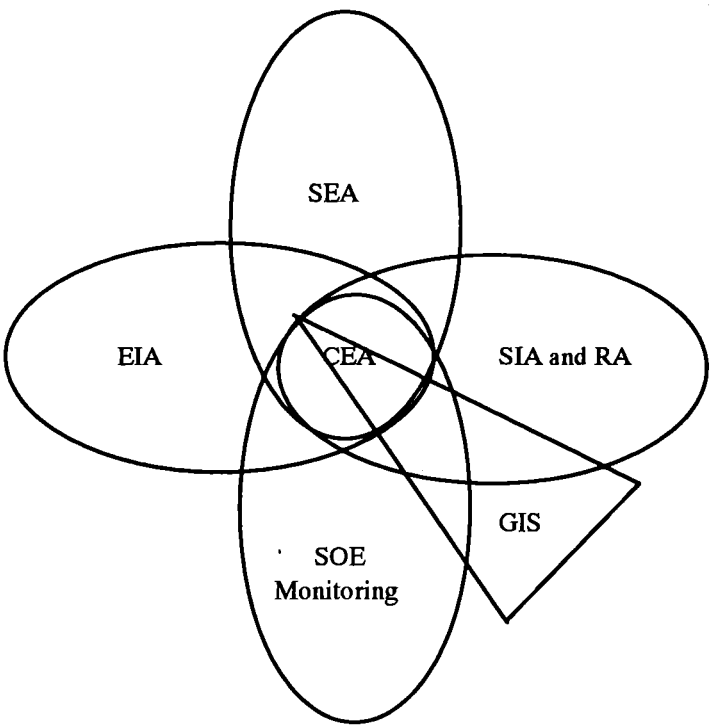


**Figure One: A combination of tools suitable for cumulative effects assessment**

It is emphasised that although the following discussion individually assesses each of the tools outlined in Figure One, they cannot be separated from each other. For instance, Strategic Environmental Assessment can use information gained from risk assessments, social impact assessments, and environmental impact assessment and use GIS to analyse future scenarios. Information gathered from project based EIA's can be incorporated into SOE monitoring, and so on.

### 4.2.1 Environmental Impact Assessment (project-based)

Table Eight, summarises the role of EIA with regard to the 'framework for analysis'. In general, EIA contributes to cumulative effects assessment by:

- Enabling greater understanding of the state of the environment and environmental change through empirical analysis and modeling (Spaling and Smit, 1993: 589);
- Assessing biophysical as well as socioeconomic effects resulting from any proposed activity; and

- Anticipating adverse environmental effects from an activity and suggesting strategies for the mitigation of such impacts" (Cocklin, Parker and Hay, 1992a: 31);

| 'Framework for Analysis' Criteria | Does EIA satisfy this criterion? |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | Yes, in theory, no, in practice (reactive and site specific) |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Yes, EIA can use historical and current data in its analysis |
| 3. Assessment of compounding and synergistic pathways | No, EIA is constrained on both a temporal and spatial scale |
| 4. Examination of biophysical and socioeconomic effects and their interactions | Yes in theory but limited in practice |
| 5. Assessment of thresholds, resilience levels | Sometimes, if impact requires such assessment |
| 6. Ways of incorporating incidences of significance | No, based on empirical data, whereas significance is generally normative |
| 7. Anticipation of future effects | Yes for individual projects, no for combination of projects |
| 8. Consideration of future management priorities | No, based largely on empirical data |
| 9. Flexible and ongoing process | Promises to be more flexible in future |

Table Eight: EIA under the 'framework for analysis'

In practice, however, impact assessment is limited by temporal and spatial constraints. Temporal boundaries of EIA are commonly characterised by short time frames, usually determined by a project's life cycle with primary emphasis on the implementation phase. Spatial scales are often confined to the local context, usually delineated by project or administration boundaries (Spaling and Smit, 1993: 589).

Assessment is often narrowed to: consideration of single disturbances on a specific environmental attribute; simple cause-effect relationships and direct impacts of an activity. As a result, environmental change involving multiple disturbance, complex causation, secondary or indirect impacts, interacting processes (synergistic or threshold effects), time lags and extended spatial boundaries are not analysed within the traditional EIA framework (Spaling and Smit, 1993: 589). The site-specific nature of 'traditional'

EIA often results in the combined effects of two or more developments being overlooked. Hence, activities characterised by individually minor, but collectively significant impacts usually fall outside the scope of this tool (Cocklin, et al, 1992a: 31).

EIA is identified by Cocklin et al (1992a: 31) as a reactive approach to environmental management. An EIA process is usually triggered after a decision has been made to initiate a development activity, hence restricting the ability of EIA to influence an activity's original justification and design.

A project focused EIA also tends to disregard environmental change induced by higher levels of decision making (programs and policies) which are frequently the driving force behind individual projects (Spaling and Smit, 1993: 589). The administrative and regulatory process is necessarily selective in that not all types and levels of decision making are assessed for their environmental effects (Spaling and Smit, 1993: 590). For instance, farming and day-to-day household activities such as commuting and home heating are generally exempt from EIA requirements. However, they eventually cause widespread and significant cumulative environmental change (Spaling and Smit, 1993: 590). Cocklin, et al (1992a: 31) also note cumulative socio-economic impacts have not been adequately accommodated within environmental assessment.

In response to the above shortcomings, the scientific basis and institutional context of environmental impact assessment is shifting to incorporate consideration of cumulative environmental change (Spaling and Smit, 1993: 590). Analytical shifts include expanded

spatial boundaries apparent in regional approaches to environmental assessment, extension of existing EIA methodologies for cumulative effects analysis and monitoring for cumulative effects. Administrative shifts include more flexible application of EIA to projects, programs or policies and regulatory actions and organisational reforms that explicitly recognise cumulative effects (Spaling and Smit, 1993: 590).

However, such changes will not automatically ensure environmental impact assessment will be able to accommodate assessment of cumulative effects. Rather, project-based EIA should be used to provide empirical information in combination with other tools including those based on more normative values.

### 4.2.2 Strategic Environmental Assessment

Strategic environmental assessment (SEA), can address cumulative effects at both project and policy level. It utilises planning principles and procedures to determine an order of preference among a set of resource allocation choices to select acceptable future growth scenarios. *"Planning principles and normative values are applied to evaluate various trade offs among alternative economic, social and environmental objectives"* (Spaling and Smit, 1993: 590). EIA (project based) is still considered a part of this framework, but is relegated to its traditional role of generating information on cumulative effects, for specific project decisions. (Spaling and Smit, 1993: 590). Table Nine, summarises the relationship of SEA to cumulative effects assessment based on the 'framework for analysis.'

| 'Framework for Analysis' Criteria | Does SEA satisfy this criterion? |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | Yes, through the use of empirical and normative values |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Yes, SEA is not constrained temporally |
| 3. Assessment of compounding and synergistic pathways | No, although not constrained on a temporal or spatial scale, empirical data regarding interactions is limited |
| 4. Examination of biophysical and socioeconomic effects and their interactions | Yes, should look holistically |
| 5. Assessment of thresholds, resilience levels | Yes, uses normative and scientific analysis |
| 6. Ways of incorporating incidences of significance | Yes, incorporates society's values regarding what is significant as well as empirical data |
| 7. Anticipation of future effects | Yes, assesses possible growth scenarios |
| 8. Consideration of future management priorities | Yes, based on multi-goal objectives |
| 9. Flexible and ongoing process | Yes, must be flexible to incorporate changing values |

Table Nine: SEA under the 'framework for analysis'

SEA provides a wider temporal and spatial context for assessing the cumulative significance of projects and plans allowing for interdisciplinary and process oriented analysis. However, inherent difficulties relating to strategic environmental assessment include issues of time, resources and expertise[7]. Also, strategic environmental assessment does not overcome the difficulty of assessing synergism and other compounding processes that are central to the cumulative effects concept.

[7] These issues will be discussed further in the next section which looks at the incorporation of cumulative effects into decision making.

### 4.2.3 State of the Environment Monitoring

State of the environment (SOE) monitoring is used to establish base-line conditions and may also serve to indicate the nature and extent of environmental stress and response (Cocklin, et al, 1992a: 40). The relationship of SOE monitoring to the 'framework for analysis' is outlined in Table Ten, below.

| 'Framework for Analysis Criteria | Does SOE monitoring satisfy this criterion? |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | Yes, if done on a regional level |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Yes, SOE monitoring can use historical and current data in its process |
| 3. Assessment of compounding and synergistic pathways | Yes, but few available techniques to assess these pathways. |
| 4. Examination of biophysical and socioeconomic effects and their interactions | Yes in theory but limited in practice |
| 5. Assessment of thresholds, resilience levels | Yes, supplies information to formulate threshold levels. |
| 6. Ways of incorporating incidences of significance | No, based on empirical data, whereas significance is generally normative |
| 7. Anticipation of future effects | No, generally a description tool for existing processes |
| 8. Consideration of future management priorities | No, as above |
| 9. Flexible and ongoing process | Yes, approach can adapt to change |

Table Ten: SOE monitoring under the 'framework for analysis'

SOE monitoring is designed to examine cause and effect processes throughout time. To date, SOE monitoring has generally focused on biophysical and chemical ecosystem characteristics through the use of indices and indicator species with little written about monitoring of socioeconomic cumulative effects. In general, SOE monitoring is an information gathering tool that deals with empirical analysis, but cannot by itself comprehensively assess cumulative effects.

### 4.2.4 Geographic Information Systems

Geographic information system can assist cumulative effects assessment (refer Table Eleven) because of its ability to compile, process and evaluate data collected over a long time period for a large geographic area[8] (Cocklin et al 1992b: 59).

| 'Framework for Analysis' Criteria | Does GIS satisfy this criterion? |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | Yes, can further understanding |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Yes, GIS can use data from any different time scales |
| 3. Assessment of compounding and synergistic pathways | Yes, in part can incorporate models |
| 4. Examination of biophysical and socioeconomic effects and their interactions | Yes in theory but limited in practice |
| 5. Assessment of thresholds, resilience levels | Yes, supplies information to formulate threshold levels. |
| 6. Ways of incorporating incidences of significance | No, based on empirical data, whereas significance is generally normative |
| 7. Anticipation of future effects | Yes, can present what if scenarios |
| 8. Consideration of future management priorities | No, does not deal with normative values |
| 9. Flexible and ongoing process | Yes, can be easily adapted with changing information needs |

Table Eleven: GIS under the 'framework for analysis'

GIS can analyse spatial relationships between biophysical and socioeconomic aspects of the environment including such dimensions as proximity and space crowding. GIS can analyse spatial changes over time, for instance relating to population change or habitat destruction. One of the main benefits of GIS in relation to cumulative effects assessment is its capacity to analyse scenarios for the future. GIS is also a flexible system which can incorporate changing information and analysis needs.

[8] From this particular strength, there are the attendant problems of reconciling the scale, accuracy and dates of capture, since these ultimately have a determining effect of the accuracy of the analysis (Cocklin et al, 1993: 403).

However, GIS is only an information display and analysis tool. It cannot by itself draw causal links between processes. These must be gained from normative values and analysis methods such as environmental impact assessment for which GIS can be a useful complement. The application of GIS in cumulative effects assessment has been limited in practice with much work assessing cumulative change on wetlands[9]. Such studies may have been possible due to defined boundaries on a limited spatial scale. Other cumulative environmental change perturbations such as global warming and regional loss of biological diversity do not have such defined boundaries and are therefore not easily managed in a computer database such as geographic information systems.

### 4.2.5 Social Impact Assessment and Risk Assessment

To date there has been little written regarding cumulative change in social impact assessment (SIA), risk assessment (RA), technology assessment or cost benefit analysis in spite of the fact that discussion has highlighted the importance of assessing biophysical and socioeconomic impacts in a cumulative assessment. Table Twelve, summarises the importance of SIA and RA to cumulative effects assessment.

Social impact assessment (SIA) uses normative and empirical values to analyse the effects of social change from specific activities on populations or communities. By incorporating both the causative agents of change and the consequences of actions,

[9] Cocklin, Parker and Hay (1992b: 60) applied GIS to a case study of CEA on the impact of agriculture upon wetlands in the Meremere Ecological District in the North Island of New Zealand. While, Johnston and others (1988) completed a similar study regarding wetlands in the Minneapolis-St Paul Metropolitan area in the United States.

social impact assessment can analyse the 'significance' of change and society's toleration associated with development and growth.

| 'Framework for Analysis' Criteria | Do SIA and RA satisfy this criterion? |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | Yes, similar to EIA in that both are often reactive and site specific |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Yes, SIA and RA can use historical and current data in its analysis |
| 3. Assessment of compounding and synergistic pathways | No, SIA and RA are constrained on both a temporal and spatial scale |
| 4. Examination of biophysical and socioeconomic effects and their interactions | Yes, but more emphasis on socioeconomic/ political effects |
| 5. Assessment of thresholds, resilience levels | Sometimes, if impact requires such assessment |
| 6. Ways of incorporating incidences of significance | Yes, specifically look at significance indices |
| 7. Anticipation of future effects | Yes, look to future scenarios (still limited by similar scope as EIA) |
| 8. Consideration of future management priorities | Yes, largely based on normative values and future consequences of actions |
| 9. Flexible and ongoing process | Depends on context and scope of assessment |

Table Twelve: SIA and RA under the 'framework for analysis'

Risk assessment also combines the use of normative and empirical information to examine differences in the willingness to accept risk and conditions influencing the acceptability of risk (Vlachos, 1983: 77). Future management scenarios can be based on what society sees as 'significant.'

Limitations regarding social impact assessment and risk assessment are similar to project based EIA in that they are restrained temporally and spatially. Difficulties also arise when assessing conflicting and competing demands of individuals and collectivities (across cultural, political, gender and religious boundaries) and their differential perceptions of risk and impact. It should be noted that these difficulties are inherent in any normative based assessment.

## 4.3 Conclusion

Although the assessment of cumulative effects is conceptually and methodologically complex, the previous discussion has shown that there already exist in current practices, overlapping approaches for assessing cumulative effects (even in the absence of a structured methodology). Table Thirteen, highlights the numerous tools available to deal with cumulative effects on both a normative and empirical basis.

| Criterion | Tools to satisfy criterion |
|---|---|
| 1. Understanding current State of the Environment and existing cumulative change processes | EIA, SOE Monitoring |
| 2. Assessment of extent to which past cumulative effects condition existing environment | Historical Surveys, EIA, GIS |
| 3. Assessment of compounding and synergistic pathways | SOE Monitoring |
| 4. Examination of biophysical and socioeconomic effects and their interactions | EIA, SIA, GIS, RA |
| 5. Assessment of thresholds, resilience levels | SOE Monitoring |
| 6. Ways of incorporating incidences of significance | SEA, |
| 7. Anticipation of future effects | SEA, EIA |
| 8. Consideration of future management priorities | SEA |
| 9. Flexible and ongoing process | SOE Monitoring, SEA |

Table Thirteen: Combination of tools available to cumulative effects assessment based on the 'framework for analysis'

Rather than developing new tools, it is necessary to formulate a strategy which combines existing tools within political considerations. While most people recognise the need for comprehensive and anticipatory tools for cumulative effects assessment, in practice analytical techniques are hindered by political and institutional issues such as time and resource constraints. The next section will examine how the assessment of cumulative effects can be incorporated into decision making and policy development taking into account political, institutional and economic requirements.

# 5.0 Cumulative Environmental Change in the Decision Making Framework

## 5.1 Introduction

The purpose of this section is to examine ways in which cumulative effects assessment can be incorporated into environmental decision making. The previous section outlined the many tools that can be used to assess cumulative effects based on the 'framework for analysis' formulated in Section Three. However, in practice these tools are constrained by social, political and institutional arrangements. Issues highlighted in the literature can be grouped under three headings (these are in no particular order):

1) Institutional constraints including policy and institutional fragmentation;
2) Administrative constraints including issues of time, cost and expertise; and
3) Methodological constraints including ambiguities and uncertainty in assessment.

This section will first, identify the aim of decision making with regard to cumulative effects. Second, the issues identified in literature under the above three headings will be discussed. Finally, practical requirements for cumulative effects assessment are outlined. These requirements incorporate tools as well as social, political and institutional conditions.

## 5.2 Cumulative Effects in Decision Making

Decision making, incorporating cumulative effects assessment, attempts to overcome the limitations inherent in the 'tyranny of small decisions.' As Figure Two highlights, environmental decision making encompasses not only tools to identify the cases and consequences of actions but also policies and plans.

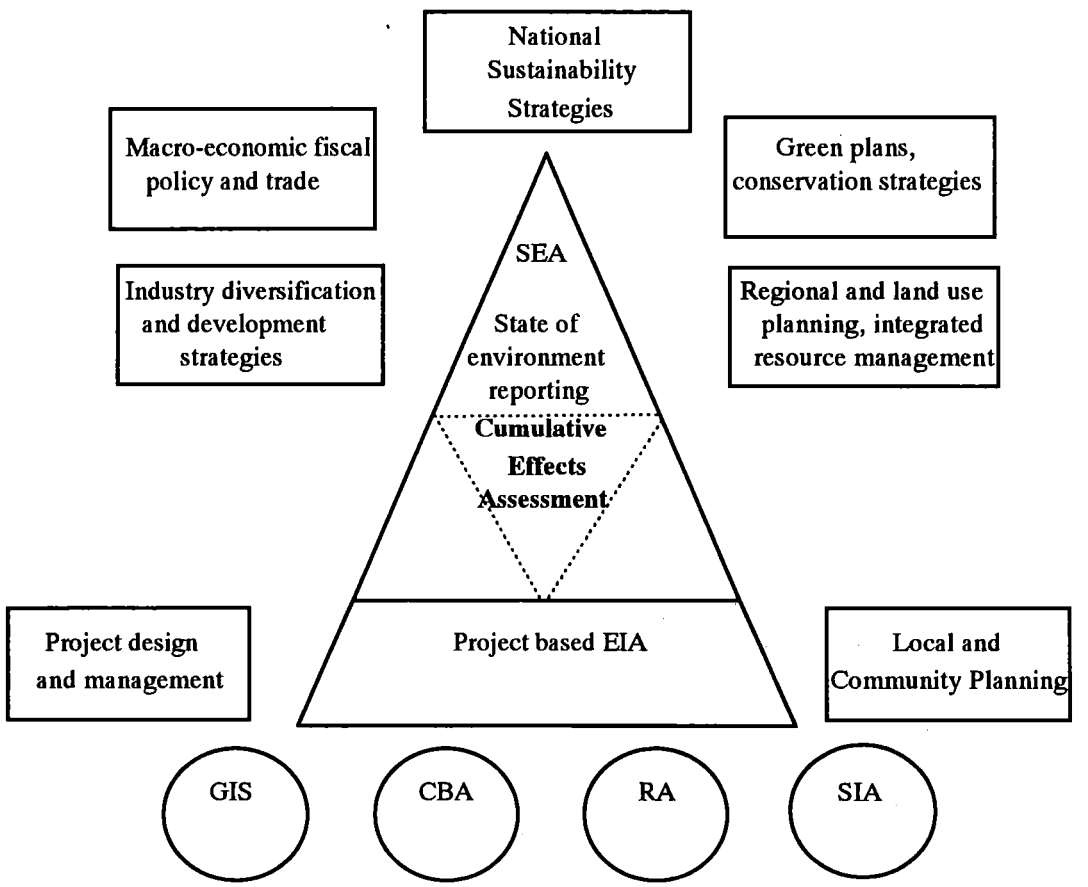


Figure Two: Cumulative effects assessment in environmental decision making. Adapted from: Wood, 1995: 299

Because the mechanisms outlined in Figure Two are designed to assess effects over time, across disciplines (economic, social and ecological) and at different levels (national to local), assessment at the practical level is complex and fraught with difficulties.

## 5.3 Institutional Constraints

The previous section highlighted the need to integrate tools to achieve comprehensive assessment of cumulative effects. For instance, it was stated that strategic environmental assessment requires other tools including project-based EIA and SIA, to provide both normative and empirical information. In reality, however, there is much fragmentation with regard to tools and policies in cumulative effects assessment and generally in environmental management.

Bührs and Bartlett (1993: 137) recognise that environmental policy is fragmented in at least three ways:

- First, biophysical elements of the environment are often thought of as embodying distinct resources, media and systems (air, water, energy, etc.);
- Second, the ecological, social and economic dimensions of the 'environment' are often understood and assessed individually. *"Those government institutions responsible for economic and social policy operate with narrow mandates independently of those responsible for environmental ....policy"* (Bührs and Bartlett, 1993: 137); and
- Third, policy traditionally centres on mitigating effects immediately rather than on the sources of the effects. For instance, chemically treating drinking water rather than dealing with the cause of pollution.

As a result, policy and decision making is frequently reactive and piecemeal resulting in recognition of cumulative effects only after they reach a 'significant' threshold level. By then impacts may be irreversible with control nearly impossible. Reactive and ad hoc policy making and planning results in decision makers having the unenviable task of

evaluating who is to blame for the cumulative effects that go over the threshold - the last project or all previous developments? - and who is going to pay?

Fragmentation also occurs between institutions due to individual agendas and administration boundaries. Vlachos commented in 1988 (page 77) that there was no collective requirement among agencies for cumulative effect assessment. Nearly ten years later institutional support for cumulative effects continues to be limited. Although phenomena such as acid rain and climate change show that pollution does not respect boundaries, no agency is given the responsibility to view issues of such far-reaching scope. It should be noted that reductionism and specialisation is not unique to politics but also occurs in academia with narrow expertise in a single discipline advocated[10].

## 5.4 Administrative Constraints

Perhaps one of the main reasons for the lack of recognition regarding cumulative effects in decision making is that it is more economically expensive and time consuming in the short term than the current decision making practices. It is unrealistic (time and cost wise) to expect a proponent to assess the anticipated cumulative effects from a proposed action such as a 10 acre subdivision. It is also unrealistic for an agency, such as a regional authority, to assess cumulative effects from all activities on all environmental media. Apart from the lack of coordination between institutions/policies/tools there are also the issues of limited time and resources available to carry out such assessments.

[10] Some degrees such as the M.Sc (Resource Management) at Lincoln University recognise and teach the importance of integrated environmental management.

## 5.5 Methodological Constraints

Although cumulative effects assessment is recognised as important for environmental decision making, it is not widely understood. Its complexity makes it difficult to explain and 'sell' to politicians, planners and the public. What should be recognised is that decisions regarding cumulative effects do not need to be (and realistically cannot be ) based on logical processing of complete information. Rather decision making with respect to cumulative effects will be done with a degree of uncertainty incorporating subjective and preference-oriented evaluations such as a precautionary principle. At issue is the 'weighting' given to subjective values over more 'scientific' data. To date, much emphasis has been placed in decision making on 'scientifically' proving impacts.

Stakhiv (1988: 726) recognises that even if information tools such as EIA and SIA were able to provide accurate information regarding consequences of human action, there would still have to be exclusionary choices made about competing social, economic and ecological objectives. Humans are going to continue activities that have adverse effects, hence, trade offs among competing resource uses and environmental management objectives are inevitable. The imperatives of capitalist economics often result in development and economic growth taking priority over environmental goals.

Bührs and Bartlett (1993: 726) reinforce this view when they note that *"formal and informal power structures favour ad hoc bargaining, short term pragmatism and powerful private interests such as businesses, often at the expense of public goods."*

Benefits of human actions are usually immediate and personal, whereas the benefits of reducing adverse cumulative effects are long term and societal. In addition, limiting cumulative environmental effects often conflicts with deeply held notions of individual freedom (Orians, 1995: 7). This is especially apparent when authorities give consent to one application because adverse impacts are considered minor and decline another application in the same area because the combination of actions would result in a significant impact.

Devising policies to reduce or eliminate the adverse cumulative effects of human activity is difficult politically because effective policies usually restrict actions that people regard as beneficial. For example, exploiting natural resources often results in individual financial reward (Orians, 1995: 7). Individuals often want the environment protected and future generations provided for, but are not prepared to accept a lower level of goods and services today to ensure an adequate level in the future (Orians, 1995: 7). For example, communal resources are overexploited with the free market ideology and consequent property rights resulting in landowners having little economic incentive to preserve species and resources which lack market value (Orians, 1995: 33).

In sum, reasons why cumulative effects assessment is not usually practised include the lack of time, resources and expertise, institutional and political fragmentation, limited theoretical and methodological knowledge of the topic, and last but not least, lukewarm commitment to cumulative effect consideration and limited support for the far-reaching analysis that the identification of cumulative impacts entail (Vlachos, 1983: 77). Therefore successful institutionalisation of cumulative effects assessment is ultimately

dependent on a supportive foundation of interests and values as well as a political culture that values the survival of the earth for future generations.

## 5.6 Practical Conditions for Cumulative Effects Assessment

Decision making with regard to cumulative effects must contend with the difficulty of balancing social needs and environmental constraints with an incomplete knowledge base and conflicting demands. From the above discussion a number of conditions can be identified that need to be fulfilled before cumulative effects assessment can be implemented in practice. They are as follows:

- the need for agreed and negotiated goals across boundaries of politics, commerce, science and society in general;
- the need for institutional reform based on the above goals including integration and co-ordination;
- the acceptance of uncertainty in science and decision making; and
- the need for anticipating growth and development scenarios.

- *Agreed and negotiated goals for future growth and management of an area.*

Agreed and negotiated goals can be based on a tiered forward planning process (a form of strategic environmental assessment). Formulation of agreed goals in policy at the upper level, is followed by consistent goals in plans at the second stage and by a programme at the end. The tiered system can apply at the global, national, regional or local level. For instance, the climate change convention (1992) is a global agreement aimed at decreasing carbon dioxide emissions into the atmosphere. Signatories to this

convention have agreed to reduce emissions by national, regional and local policies targeting short and long term goals[11]. An example of a successful national policy incorporating agreed goals is the National Environmental Policy Plan (NEPP) adopted by the Dutch Government in 1990. This plan's central theme is that society must end its practice of making future generations pay the costs of environmental degradation (Orians, 1995: 33). It is recognised that there will never be a consensus of views at any level, and trade offs will still occur. Progress will be made in spite of instances where too much compromise results in policy that achieves nothing. Education and further information gained through the use of tools such as state of the environment monitoring will enable more and more 'informed' decisions with regard to the use of the environment.

- *Institutional reform based on agreed goals including integration and co-ordination.*

Agreed goals and objectives need to take into account different disciplines (economics, sociocultural and ecological dimensions) as well as time and space requirements. There is therefore a need for political and institutional co-ordination. Economic policies need to be integrated with conservation policies depending on the objectives for future growth and management. Once again, tools for information provision and transfer are important to enable society to make 'better informed decisions' regarding resource use.

[11] The climate change agreement has to date not been successfully implemented with many countries reneging on their short term goals. It may be that the agreed goals and objectives are before their time - a bit like the tail wagging the dog!

- *The acceptance of uncertainty in science and decision making.*

There also needs to be a change in values in science and decision making with regard to the acceptance of uncertainty. Because of the complexity of cumulative effects assessment, including the need to assess third- and fourth- order impacts, decision making cannot be based on definitive knowledge. It is not acceptable to make a non-decision on an issue because of the lack of 'scientific' data. Recently, 'fuzzy logic' has been implemented in various sciences to manage issues of uncertainty and decisions are also being made with less complete 'scientific' evidence. For instance, the climate change convention (1992) was initiated with recognition of disagreement among scientists as to the exact cause of the phenomenon.

- *Anticipating growth and development scenarios.*

Scenarios for future growth and development must be assessed against agreed and negotiated societal goals. All policies, plans and programmes (such as consent actions) then need to be consistent with these goals. Strategic environmental assessment is an important tool which can accommodate anticipated cumulative effects. In this context, any assessment tool must enable ongoing monitoring (such as state of the environment monitoring) and be flexible because societal values and goals will alter over time.

The next section examines the issues of cumulative environmental decision making in the New Zealand context. The practical 'requirements' for cumulative effects assessment outlined above will be specifically related to decision making under the Resource Management Act (1991).

# 6.0 The New Zealand Context

## 6.1 Introduction

Although the Resource Management Act (RMA)(1991) is not the sole legislation in New Zealand relevant to environmental management - others include the Environment Act (1986), the Conservation Act (1987), and the Hazardous Substances and New Organisms Act (1996) - it is the only legislation that explicitly refers to 'cumulative change over time.' Hence, it is the purpose of this section to examine how cumulative effects are provided for under the Resource Management Act (1991) and identify issues that need to be addressed for more effective implementation. Analysis also relates to the Environment 2010 Strategy (2010) although it is recognised that such a Strategy is not 'required' under the RMA (1991).

This Section will first, outline the 'planning' framework under the RMA (1991). Second, the interpretation of cumulative effects in New Zealand is discussed. Third, the RMA (1991) is 'tested' against the 'framework for analysis,' outlined in Section Three. Finally, the requirements for cumulative effects assessment, outlined in Section Five, are discussed with regard to the RMA (1991).

## 6.2 The Resource Management Act (1991) in Context

The RMA (1991) integrates planning and environmental assessment procedures that were previously administered under a number of statutes, most notably the Town and

Country Planning Act (1977), Water Conservation Act (1967) and the Environmental Protection and Enhancement Procedures (EPEP) developed by the Commission for the Environment in 1974 (Dixon and Montz, 1995: 446).

The RMA's (1991) overriding purpose of sustainable management of natural and physical resources is provided through a framework for integrated resource management, of which environmental impact assessment forms a central part (Dixon and Montz, 1995: 447). Assessment of Environmental Effects is implemented by local authorities at two interlinked levels under the RMA (1991). Firstly in policy analysis and plan preparation at regional and local levels, and secondly in the assessment of applications for resource consents and permits (Dixon and Montz, 1995: 447). Policies and objectives in policy statements and plans establish criteria for consideration of applications for resource consents on a day-to-day basis.

Regional authorities are required to prepare regional policy statements that provide an overview of the resource management issues and objectives relating to their region. Regional plans are optional and can be prepared on a range of matters but are required to be consistent with regional policy statements. Similarly, district and city councils are required to prepare district plans in order to assist councils to achieve the purposes of the RMA (1991) (Dixon and Montz, 1995: 447). These plans must also be consistent with regional policy statements and plans. Council staff need to develop an understanding of the interrelationships between biophysical systems, social and community needs, existing land-use patterns and anticipated developments and reflect

this in the form of integrated policies and objectives. This requires cooperation on an interdisciplinary basis and specific abilities in terms of presenting an overall assessment of the local and regional state of the environment before policies and objectives can be formulated (Dixon and Montz, 1995: 448).

## 6.3 Interpretation of Cumulative Effects in New Zealand

Section Three of the RMA (1991) outlines the meaning of effects. It includes *"any cumulative effect which arises over time in combination with other effects regardless of the scale, intensity, duration or frequency of the effect."* This interpretation is very broad and could incorporate any of the three cumulative effect typologies outlined in Section Two. For instance:

- The words, *"arises over time,"* embody the 'time crowding' dimension outlined in the CEARC (1985) typology and 'diachronic effects' referred to in Vlachos's (1983) typology.
- The words, *"in combination,"* incorporates 'pathways of accumulation' as outlined in Cocklin, et al's (1992) typology. The 'compounding effects' criterion in the CEARC (1985) typology and Vlachos's (1983) 'sum incremental effects' and synergistic effects' classification can also be related.
- The words, *"with other effects,"* incorporates the "space crowding" phenomenon outlined in the CEARC (1985) typology as well as the 'sources of change' dimension in Cocklin, et al's (1992a) typology.
- The passage, *"regardless of scale, intensity, duration or frequency of the effect,"* can relate to the 'time lag, extended boundaries, triggers and thresholds, indirect

effects and patchiness effects' criteria outlined in the CEARC (1985) typology as well as the 'impact accumulation' dimension of Cocklin et al's (1992a) typology and 'significant impacts' classification in Vlachos's (1983) typology.

The broad nature of the legal definition of cumulative effects is not surprising. The RMA (1991) is not a definitive document but rather a framework for environmental management in New Zealand, giving much scope for discretion at the implementing levels. What is surprising, however, is the lack of guidelines prepared by policy advice agencies such as the Ministry for the Environment and Parliamentary Commissioner for the Environment regarding cumulative effects. Dixon and Montz (1995: 445) note that guidelines for environmental impact assessment have provided little direct acknowledgment of the significance of cumulative effects.

For instance, in the Ministry for the Environment's paper - *Resource Management: Scoping of Environmental Effects (1992: 5)* - the interpretation of cumulative effects was referred to in passing. An extract, below shows that the guidelines offered by MfE (1992) are just as broad and complex as the legal definition in the RMA (1991).

> "The simplest approach is to think of the way individual actions can become significant over a period of time. Considered separately, actions could be minor. Collected together over several months or years they could adversely affect the environment. In some circumstances it may be inadvisable to permit the first of several actions. In others, the threshold marking the upper level of cumulative effect which is not adverse may be understood and actions permitted until the threshold is reached. Policy statements and plans should provide guidance on which of these options will apply and when. Similarly previous actions may have had adverse effects to the point where it is inadvisable to permit any further activity. An effective response to cumulative effects requires an understanding of intended environmental outcomes or conditions. This is critical for any assessment of the way or degree of accumulated effect" (MfE, 1992: 5).

What is **not** outlined in the MfE's scoping paper (1992) include;

- The spatial dimension of cumulative change - the environment is interrelated and cumulative effects do not stop at administration boundaries, therefore who's duty is it to analyse cumulative change between regions and at the national level?
- The temporal dimension - how far into the future should assessment of cumulative change go?
- Whether single or multiple sources of activity need to be assessed.
- Whether an 'accumulation of impacts' or 'an accumulative impact' should be assessed.
- Whose responsibility it is to assess/monitor cumulative effects.
- Who bears the responsibility when the threshold is reached?

The Parliamentary Commissioner for the Environment's (PCE) Paper - *Assessment of Environmental Effects: Administration by Three Territorial Authorities* (1995) - also recognises cumulative effects as being important under the RMA (1991).

> "Under the "sustainable management" regime of the RMA the evaluation of cumulative effects is a specialised and critical area to which councils should give great care when evaluating AEE information" (PCE, 1995: 42)

PCE uses case law[12] to define cumulative effects assessment, believing it may also include future effects which are inevitable and predictable and hence allow a resource consent to be denied on the grounds that approving it would set a precedent.

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[12] The concept of cumulative effects was discussed in *Berhampore Residents Association v Wellington City Council W54/92* and *Heigl v Porirua City Council W64/92* where cumulative effects could include predictable effects if a certain consent pattern is established (*Manos and Coburn v Waitakere City Council (1993) (PT) and Lee v Auckland City Council 1995).* In *Cash v Queenstown Lakes District Council (1993)(PT)* it was found that where a proposal consists of multiple resource consent applications, the local authority must consider the cumulative effects of all the consents, if granted. In *Burton v Auckland City Council 1994* it was held that where several consents are required for the same project the AEE should take into account the relevant cumulative effects of the whole development. In the cases *Manos v Waitakere City Council and Gardner v Tasman District Council 1994* it was stated that cumulative effects should not be judged solely on the effects an activity would have on the zone for which it was proposed but also the cumulative effects caused by the loss of that activity to zones where it was positively encouraged were also a consideration.

Judge Treadwell (1997) an Environment Court Judge in New Zealand stated in a recent speech for the Planning Institute that the word 'cumulative' used in the context of the RMA (1991) means *"in addition to what is there....It does not mean a catalyst leading to future problems."* Judge Treadwell (1997) suggests the RMA's definition of cumulative effect does not include *"which may arise over time or which may in future combine with other effects should other activities of a like nature become established - activities not presently in contemplation."* Treadwell (1997) believes to extend it to cover *"such as element of futurity"* recognises an element of precedent of which the RMA is **not** concerned with, hence contradicting the Ministry for the Environment (1992) and recent case law in New Zealand. This contradiction is cause for concern.

Although cumulative effects are recognised and provided for in the RMA (1991), the legal definition of cumulative effects is broad as are guidelines for their assessment. As well, a number of influential institutions and individuals are giving contradictory advice as to the assessment of cumulative effects. Hence, there is a very real need for institutional recognition of the importance of cumulative effects in New Zealand. Guidelines need to define cumulative effects in a manner that is consistent and manageable in practice. It is little wonder that implementing agencies are not currently undertaking cumulative effects assessment with the conflicting advice that is being provided at 'higher' levels.

## 6.4 Analysing Cumulative Effects under the RMA (1991)

Although no legal guidelines with regard to cumulative effects have been formulated in New Zealand, the 'framework for analysis' outlined in Section Three of this report can be used to identify whether cumulative effects can be assessed under the RMA (1991) (refer Table Fourteen).

Table Fourteen shows that, on a conceptual level, the RMA (1991) has the mechanisms to assess cumulative effects in New Zealand. However, it has been highlighted in literature (Tasker, 1997, Dixon and Montz, 1995, Cocklin et al, 1992a and b) that to date assessment of cumulative effects in New Zealand is not occurring. The question arises - why, with an institutional framework that is consistent with cumulative effects assessment, are cumulative effects not being assessed in New Zealand?

Previous sections have highlighted the general constraints of time, resources and lack of tools for assessment of cumulative effects at the consent process stage and lack of expertise at the plan and policy statement stage. These issues are also apparent in New Zealand with developers and farmers already complaining about the costs of providing more environmental information under the RMA (1991) (Dixon and Montz: 449). The literature (PCE, 1995: 12, Morgan, 1994: 160, Dixon and Montz, 1995: 449) also highlights inexperience of local authorities with regard to strategic environmental assessment.

| 'Framework for Analysis' Criteria | Is the criterion satisfied by the RMA (1991)? |
|---|---|
| Regional basis | Yes, the RMA (1991) devolves responsibility from central to regional and territorial government. Regional authorities are assigned an overview role and are required to assess the environment as an integrated entity. Within this framework site specific decisions should be made with reference to regional policy statements and regional and district plans. Also, administration boundaries are based on 'physical' boundaries such as water catchments rather than 'political' boundaries. |
| Understanding of current state of the environment | Yes, SOE monitoring is required under Section 35 of the RMA (1991) as well as monitoring of consent conditions. |
| An assessment of past conditions | In part, State of the Environment monitoring and other assessment tools can use historical information and surveys |
| An approach to assessing compounding pathways, etc. | Yes, the RMA (1991) sets out an integrated management system at the regional and local levels. |
| An examination of biophysical and social effects | Yes, Section 5 of the RMA (1991) requires 'sustainable management' of people's social, economic and cultural well being as well as sustaining the natural and physical resources |
| Assessment of thresholds | In part, the word 'bottomline' is not specifically referred to in the RMA (1991) but words to that effect are contained in the Act e.g. life supporting capacity |
| A process for incorporating significance | Yes, public participation at both project and policy level is advocated under the RMA (1991) allowing people to voice their view regarding what is considered significant, etc. |
| Anticipation of future effects | Yes, Section 5 of the RMA (1991) requires the reasonably foreseeable needs of future generations to be provided for under the "sustainable management" purpose of the RMA. The Fourth Schedule requires assessment of both actual and potential effects |
| Consideration of priorities for future | Yes, plans and policy statements are required to incorporate objectives and policies for future management |
| A flexible and ongoing process | Yes, ongoing monitoring is required and continual review of policy statements and plans. |

Table Fourteen: Assessment of cumulative effects in New Zealand based on the 'framework for analysis.'

Issues of cost, lack of time and expertise are not specific to cumulative effects assessment but rather are apparent in environmental decision making in general. However, as stated previously the availability of strategic environmental assessment can focus the analysis and consequently cut the necessary time and resources for assessment. Section Five of this report, outlined four requirements that need to be fulfilled before cumulative effects can be assessed in any practical setting including under the RMA (1991). It is to these conditions that the remainder of the Section is focused.

## 6.5 Requirements for Cumulative Effects Assessment

### 6.5.1 The Need for Agreed and Negotiated Goals

Bührs and Bartlett (1997: 73) suggest the identification of aims and principles *"would establish common direction, priorities, and evaluate criteria by which policy action would be allocated, coordinated, and guided for greatest achievement over a period of time longer than the usual decision frame"* (Bührs and Bartlett, 1997: 73).

The RMA (1991) allows for public participation and the incorporation of goals at all decision making levels from national and regional policy statements to territorial plans. Management plans and strategies, such as vision statements have been prepared (outside the RMA (1991) by a number of local authorities. These strategies outline future growth and management scenarios on a local scale. A national policy document - *Environment 2010* - has also been prepared by the Ministry for the Environment (1995) outlining national objectives and priorities for future management.

However, in practice Bührs and Bartlett (1997: 74) suggest the RMA (1991) exempts most of central government from its provisions and provides little guidance for the integration of policy across economic, ecological, and social dimensions. Although the RMA (1991) enables central government to develop national policy statements and standards, to date, the government has chosen to issue only a mandatory national coastal policy statement which offers little firm direction (Bührs and Bartlett, 1997: 74). Regional policy statements are a starting point for environmental policy development on

a regional level, yet run the risk of being ad hoc, reactive and/or 'bland' without further guidance from central government in the form of national policy statements and standards (Bührs and Bartlett, 1997: 76).

The Environment 2010 strategy document, released in 1995, may have been developed in response to the need for national goal and priority setting in relation to the environment. Although the document only mentions cumulative effects in passing, it recognises among other things:

- The importance of values in which environmental and social goals are mutually supportive,
- The need to apply the precautionary principle in management practice, where there is limited knowledge or understanding about the potential for adverse environmental effects or the risk of serious or irreversible environmental damage; and
- The defining of 'environmental bottomlines' in situations of special sensitivity and high risk, and where adequate information exists in which to base such a definition.

Therefore on a conceptual level, New Zealand has a national document outlining agreed goals for environmental management which are consistent with requirements for cumulative effects assessment. However, Bührs and Bartlett (1997: 82) suggest that in practice the Environment 2010 document, may be a form of 'symbolic' policy which is not meant to be implemented substantively. For instance, the strategy does not specify concrete goals or targets and dates for their achievement, nor does the strategy say much about the means that will be assigned to achieving these goals. Other barriers to

achieving agreed goals include weak societal demand and institutional inefficiencies (Bührs and Bartlett, 1997: 80).

### 6.5.2 The Need for Institutional Reform

Even after the reorganisation of national environmental agencies in the mid-1980s, there are still serious gaps in organisational capacity. For instance, the Ministry for the Environment has severely limited regulatory, planning or advocacy authority and there is no national pollution control agency that is charged with overseeing pollution management across New Zealand (Bührs and Bartlett, 1997: 76).

By its very nature, cumulative effects assessment crosses departmental boundaries. For instance, transportation, energy, agriculture, economic and other policies all have serious cumulative consequences. Yet, in New Zealand these policies continue to be developed without serious consideration being given to environmental consequences such as cumulative effects (Bührs and Bartlett, 1997: 76).

Reasons for lack of institutional co-ordination are not specific to New Zealand but are similar elsewhere in the world and include issues relating to administration boundaries and fragmented departmental agendas. Bührs and Bartlett (1997: 81) also raise questions regarding responsibility and capacity for co-ordination as well as implementation and monitoring of such integrated policy when there is no co-ordinating agency with a mandate to oversee all policies (social, economic and ecological) in New Zealand.

Not only are institutions fragmented under the RMA (1991) but also assessment procedures. The RMA (1991) is restricted to focusing on environmental effects, therefore directing attention away from the sources of those effects. At present the resource consent hearing process deals with just one consent for a particular activity in a particular place at a particular time. *"If one person can show how they can avoid, remedy or mitigate adverse effects, then why should there be a rule stopping others from doing the same?"* (Tasker, 1997: 6)

The RMA (1991) reflects the current free market philosophy of New Zealand in that anyone can do anything as long as it does not create a 'significant' adverse effect. The prevailing ideological context demands less intervention and regulation for communities and greater cost efficiencies from consent authorities (Dixon and Montz, 1995: 455). This 'cultural climate' also hinders the ability of implementing agencies to plan for the future (this issue will be discussed later).

### 6.5.3 The Need to Accept Uncertainty in Science and Decision Making

The 'effects-based' nature of the RMA (1991) requires applicants to show that their development will have minor adverse effects or that those adverse effects can be avoided, remedied or mitigated. However, the RMA (1991) also requires those submitters against a development to prove that the adverse effect is significant or cannot be sufficiently remedied or mitigated. This "prove it" mentality appears to place greater weighting on 'expert witnesses' and 'hard scientific fact' over more subjective judgements. For instance, threshold levels are not placed on resources and ecosystems by

consenting agencies because without related technical data the rule would not hold up if a case went to the Environment Court.

Under the RMA (1991) public participation is incorporated into decision making at both the project and plan level. In theory, community values and preferences as well as scientific information should be taken into account in decision making at both these levels. However, in a society that places so much emphasis on 'scientific' information in decision making, the question remains as to how much weighting is placed on public values compared with more 'rational' scientific information. The Environment 2010 Strategy (1995) recognises this as an issue and advocates the use of the precautionary principle in cases where an effect is considered significant. Only recently a case - *Telecom NZ Ltd v Christchurch City Council (1996) EC*) - was denied based on the precautionary principle. This case related to the uncertainty of effects resulting from cellular phone towers. However, it was stated in the judgement that applying the precautionary principle is a matter of discretion for consent authorities.

### 6.5.4 The Need for Anticipating Growth and Development Scenarios

Regional Policy Statements and local and regional plans are required to anticipate issues relating to their area. Vision strategies produced by various councils and the Environment 2010 Strategy are also designed to anticipate growth and formulate objectives and goals for the future. Given that these vision statements are not 'required' under the RMA (1991), the issue is the amount of consideration these vision statements are given during decision making.

Under previous legislation - the Town and Country Planning Act (1977) - activities would not be allowed in particular areas through strict rules controlling activities in particular zones. Zoning allows for greater planning control and regulation and allows particular future growth scenarios to be developed because local authorities are able to anticipate where activities will be situated. Under the RMA (1991) anticipation of future development is more difficult because it is not the activity that is regulated but rather the effects from that activity. Hence, an activity can be located anywhere as long as there are no adverse effects associated with it. This creates great uncertainty and sporadic development (Tasker, 1997: 7). Tasker (1997: 7) suggests that even under the RMA (1991) many district plans are proposing strict rules for controlling activities in zones (often against the direction of the Ministry for the Environment).

## 6.6 Conclusion

Under the environmental management framework outlined by the RMA (1991) there are obstacles and strengths with regard to cumulative effects assessment in New Zealand. Cumulative effects are required to be assessed under the RMA (1991). Also, the political framework set up under the RMA (1991) including; the requirement for regional overviews, integrated management, state of the environment monitoring, environmental impact assessment and strategic assessment are beneficial for cumulative effects assessment. However, when 'testing' the RMA (1991) under the practical requirements for cumulative effects assessment outlined in Section Five, it is possible to identify why assessments are not being done in New Zealand.

- Cumulative effects are only ever mentioned in passing in policy documents and are contradictory. There are no national guidelines regarding cumulative effects assessment;
- There is no central government agency with a mandate to 'oversee' environmental policy (social, economic and ecological) on a national level;
- There have been inadequate national policy statements (no optional national policy statements) produced under the RMA (1991) with respect to goals and objectives for future management. The Environment 2010 Strategy, although highlighting priorities and objectives for future management, is not required to be implemented under the RMA (1991);
- There is a lack of co-ordination between departments and agencies, with no consistent goals (due to a lack of central guidelines);
- The RMA (1991) requires assessment of effects rather than the activity causing the effect. This creates problems for anticipating future growth scenarios and places greater emphasis on scientific evidence and the 'prove it' regime in decision making.

The next section outlines conclusions based on the four research questions posed in Section One. Recommendations to overcome the above issues and improve the current situation in New Zealand are also outlined and have been prioritised to promote strategic implementation.

# 7.0 Conclusions and Recommendations

## 7.1 Conclusions

The aim of this investigation was to identify and discuss the issues relating to cumulative effects assessment and its role in environmental decision making. Section One of this report outlined the importance of cumulative effects assessment and highlighted the consequences of reactive and incremental decision making. Despite cumulative environmental change being internationally recognised, consideration of the phenomena by politicians and planners continues to be limited. The structure of the report surrounded around four research questions aimed at finding out why, despite being recognised as important, cumulative effects are not being assessed. The four questions were: What is cumulative environmental change? How can cumulative effects be evaluated? How are cumulative effects analysed? And how can cumulative effects be incorporated into decision making and policy development?

### *What is cumulative environmental change?*

Section Two of this report focused on the first question, that of the interpretations regarding cumulative change. It was recognised that there is no universal definition of cumulative effects. Although, most conceptual frameworks of cumulative change are based on a model of causality consisting of three components: causes or sources of change; processes of change; and resulting effects (Spaling and Smit, 1993: 591). Three typologies were identified through review of literature as being representative of the

differing interpretations of cumulative effects. Cocklin et al's (1992a) source, pathway and effect typology was used for the purposes of this study because of its practical nature and ability to assess socioeconomic and biophysical effects. Other literature (Spaling and Smit, 1993: 591) also recognised this typology as being a refined classification of existing typologies.

Cumulative effects, as defined by Cocklin et al (1992a) can result from either single or multiple sources of change. For instance, a single activity can have individually minor, but collectively significant environmental effects. Cumulative effects are also a consequence of the combined impacts of multiple activities. Cocklin and Parker (1993: 395) recognise two main pathways of disturbance: an additive/crowding pathway, where each unit of activity creates a similar level of disturbance; and an interactive/compounding pathway which recognises that change can be synergistic, where two or more inputs in combination are greater than the added effects of each acting independently. Cocklin et al's (1992a) typology also outlines the eventual cumulative change. They distinguish between an 'accumulation of impacts' (in which a diverse range of impacts, perhaps unrelated, contributes to the overall degradation of the environment) and an 'accumulative impact' (when two or more, perhaps unrelated, activities contribute to a single form of environmental disturbance).

### *How can cumulative effects be evaluated?*

The evaluation of cumulative effects depends on interpretation as well as the political and institutional context that it is assessed under. Section Three, reviewed the literature

regarding theoretical aspects of cumulative effects assessment based on the interpretation outlined in Section Two. A 'framework for analysis' was formulated as a means for evaluating cumulative effects. Assessment can be performed at any level - from analysis of a single activity on a single environmental medium to assessment of multiple activities on multiple environmental media. It was recognised that the more complex analyses such as global assessment of all activities on all dimensions of the environment would be impractical. Rather, a regional analysis was recommended. This level of analysis is manageable on an information scale and yet still allows for assessment of interactions between the environment (including connections between socioeconomic and biophysical dimensions). It was also recognised that a change in thinking regarding 'traditional' environmental impact assessment is required if cumulative effects are to be assessed in practice. The new emphasis includes: looking at processes rather than species; being holistic as opposed to reductionist; acknowledging dynamism instead of taking 'snapshot' views; and anticipating effects rather than being reactive. Based on these issues a 'framework for analysing' cumulative effects was formulated (refer Section Three).

### *How are cumulative effects analysed?*

Section Four examined tools (all of which had previously been identified in literature as being able to assess cumulative effects) against the 'framework for analysis' formulated in the previous section. The purpose of Section Four was to examine how cumulative effects could be assessed using the following tools: project-based EIA, Strategic

Environmental Assessment, State of the Environment Monitoring, Geographic Information System, Social Impact Assessment and Risk Assessment.

It was recognised that all of the above mentioned tools can contribute to cumulative effects assessment, but none can comprehensively deal with cumulative effects by themselves. Rather a combination of information providing tools and normative 'planning' approaches are needed. For instance, project-based EIA, SIA and RA can provide information regarding the state of the environment and the 'significance' of change in the environment. However, it was recognised that these tools are limited in practice by spatial (e.g. site-specific, local) and temporal (e.g. reactive) constraints. Strategic Environmental Assessment is also a useful tool to assess cumulative effects through the use of normative, multi-goal objectives to determine future growth preferences. However, SEA is dependent on other tools mentioned above with GIS to help in data analysis. It can therefore be concluded that tools for cumulative effects assessment do exist. Therefore, rather than develop new tools it is necessary to formulate a strategy which combines existing tools within political considerations.

## *How can cumulative effects be incorporated into decision making and policy development?*

Section Five, dealt with the question of how cumulative effects can be incorporated into environmental decision making based on the assumption that tools do exist to deal with cumulative effects. It was the purpose of this section to examine how these tools were constrained by social, political and institutional arrangements. Issues highlighted in the literature were grouped under three headings: institutional constraints including policy

and institutional fragmentation; administrative constraints including issues of time, cost and expertise; and methodological constraints including ambiguities and uncertainty in assessment. These limitations contribute to the present lukewarm commitment to cumulative effect consideration in environmental decision making. They also highlight some practical 'requirements' that are necessary for cumulative effects to be incorporated into decision making and policy development (refer Section Five).

Section Six examined the issues of cumulative environmental decision making in the New Zealand context (specifically the RMA (1991)) based on the 'practical' requirements outlined in page 47. Although cumulative effects are defined in the RMA (1991) the legal interpretation and subsequent definitions (albeit very rare) are very broad and ambiguous. There is very little institutional recognition of the importance of cumulative effects (with the little there is being contradictory). Given the lack of recognition in New Zealand, the 'framework for analysis' outlined in Section Three was used to identify whether cumulative effects can be assessed under the RMA (1991). Regional overviews, state of the environment monitoring, integrated management and public participation are all requirements under the RMA (1991) that can also be associated with cumulative effects assessment to achieve "sustainable management.'

Yet, it is recognised in the literature that cumulative effects assessment is not being incorporated into decision making under the RMA (1991). Issues of cost, lack of time and expertise are common constraints to all environmental management in New Zealand. Therefore the 'practical requirements' outlined in Section Five were used to assess more

specific issues regarding cumulative effects assessment in New Zealand. It was found that there is a lack of agreed goals, with inadequate national policy statements or guidelines produced under the RMA (1991) catering for future management. There is fragmentation between institutions, with no agreed goals between agencies (economic, social, ecological institutions). There is no central government agency with a mandate to 'oversee' environmental policy (economic, social, ecological) on a national level. Finally, the RMA's (1991) effects based philosophy places greater emphasis on 'proving' adverse effects whereas cumulative effects assessment requires a degree of uncertainty in decision making. The RMA (1991) also hinders the ability of decision makers to anticipate future growth scenarios with its emphasis on effects rather than the action that causes the impact.

Major shifts in attitude will be needed for cumulative effects assessment to be incorporated into environmental decision making in New Zealand.

## 7.2 Recommendations

The following recommendations are based on the assumption that the importance of cumulative effects (under whatever name) is gaining wider public acceptance. Acknowledging the need for change hopefully indicates a willingness to allocate the necessary resources to improve the current situation.

### 7.2.1 Recommendation One

**It is recommended that central government agencies recognise the importance of cumulative effects assessment under the concept of "sustainable management" and provide information and advice regarding cumulative effects to implementing agencies.**

It is recommended agencies such as the Ministry for the Environment and the Parliamentary Commissioner for the Environment provide 'quality' information on cumulative effects. This would provide consistency in a setting that currently has conflicting interpretations of cumulative effects. Advice should deal with temporal and spatial dimensions of cumulative effects and include the factors outlined in the 'framework for analysis' in Section Three. This recommendation will overcome the current uncertainty regarding cumulative effects assessment in New Zealand and provide encouragement for implementing agencies to assess cumulative effects.

### 7.2.2 Recommendation Two

**It is recommended that environmental decision makers recognise the need to accept uncertainty in decision making and apply the precautionary principle where there is limited knowledge or understanding about the potential for adverse cumulative environmental effects.**

The precautionary principle should be applied in such situations at local, regional and central government and included in new legislation if not upheld in case law. This recommendation acknowledges that decisions have to be made with a degree of uncertainty given that there will never be definitive knowledge regarding second-, third- and fourth-order impacts. Guidelines as to when to apply the precautionary principle should be produced by central government agencies such as the Ministry for the

Environment so as to allow for consistency across the decision making levels. These guidelines would largely prevent the application of the precautionary principle creating a perpetual impasse.

### 7.2.3 Recommendation Three

**It is also recommended that there be further research regarding cumulative change processes in the environment with appropriate tools to assess these changes and that this information is communicated to appropriate bodies.**

This recommendation recognises the lack of research regarding cumulative effects that currently exists in New Zealand. It also acknowledges the dynamic nature of cumulative environmental change and therefore the need for ongoing monitoring and assessment. Not only will further information create greater understanding of cumulative effects and the ways to deal with cumulative environmental degradation but it will also enable decision makers and the 'public' to make more 'informed' decisions with regard to environmental management in New Zealand. In as much as more information does not necessarily mean better decisions the results of this research should be disseminated through channels such as state of the environment monitoring.

The above recommendations are designed to be implemented in the short term (within the next two years). They are necessary to increase understanding of cumulative effects and promote support for consideration of cumulative effects in decision making. The following recommendations will require greater time and will only occur once there is support for cumulative effects assessment.

### 7.2.4 Recommendation Four

**It is recommended that a national policy statement be formulated under the RMA (1991) that identifies agreed goals regarding key environmental problems and ways to address these.**

This recommendation is in recognition of inadequate national objectives catering for future management. By having national direction and common priorities, decision making agencies (central, regional and local) can anticipate future scenarios based on these agreed goals. This commòn direction will also enable greater co-ordination between agencies (social, economic and 'environmental'). Given the diversity of views which have to be accommodated there is the risk of the statement being watered down to ineffectual verbiage. However, because the recommendation is longer term one could assume that general public appreciation of these issues would have increased and that the earlier recommendations have achieved some progress. New Zealand could look to the National Environmental Policy Plan (NEPP) adopted by the Dutch Cabinet in 1990 for a model of a national plan that attempts the managing of cumulative environmental effects.

### 7.2.5 Recommendation Five

**Finally, it is recommended (in light of the previous recommendations) that a central agency be given a mandate to 'oversee' environmental policies based on the agreed goals outlined in the proposed national policy statement.**

This recommendation recognises the lack of co-ordination between institutions and policy making in New Zealand. A central agency (which could be independent) could help achieve improvements by monitoring the agreed goals. In the current political/ideological climate such advice may appear idealistic. However, as the

seriousness of environmental degradation becomes more apparent this proposal may be viewed as less radical.

At present, the highest priority must be implementing the short term recommendations. This will increase recognition, information and guidance regarding cumulative effects assessment and promote greater support in decision making. With more information about the importance of cumulative effects, the need for agreed goals and co-ordination at all levels will become apparent and achievable.

# Erratum

Page 74 - Insert

Canadian Environmental Assessment Research Council (CEARC) typology (1985). In Cocklin, C., Parker, S., and Hay, J. (1992a) "Notes on Cumulative Environmental Change I: Concepts and Issues." Journal of Environmental Management. Vol. 35 pp 35.

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